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WASTEWATER PURIFICATION AT LAKE TAHOE

Environmental Protection Agency
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Wastewater purification at Lake Tahoe

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saving a beautiful lake

A new man-made lake, bright blue and of sparkling clarity, has been created in the Diamond Valley area of Alpine County, California, across Luther Pass in the High Sierras from one of America's leading scenic and recreational resources—Lake Tahoe.

The new lake is unique in several respects. Its contents are purified wastewater produced by a new wastewater purification plant which has been described as the most advanced water reclamation facility in operation anywhere in the world. While the impounded reclaimed wastewater is being used for recreation and irrigation, the primary reason for the creation of the new lake is preservation of Lake Tahoe.

World-famous for its beauty and clarity, Lake Tahoe has a surface area of 192 square miles. It is unusually deep, ranging down to more than 1600 feet, and it contains 122 million acre feet of water, enough to cover the entire state of California to a depth of 14 inches. It is rated as one of the three clearest lakes in the world, along with Crater Lake in Oregon and Lake Baikal in Russia.

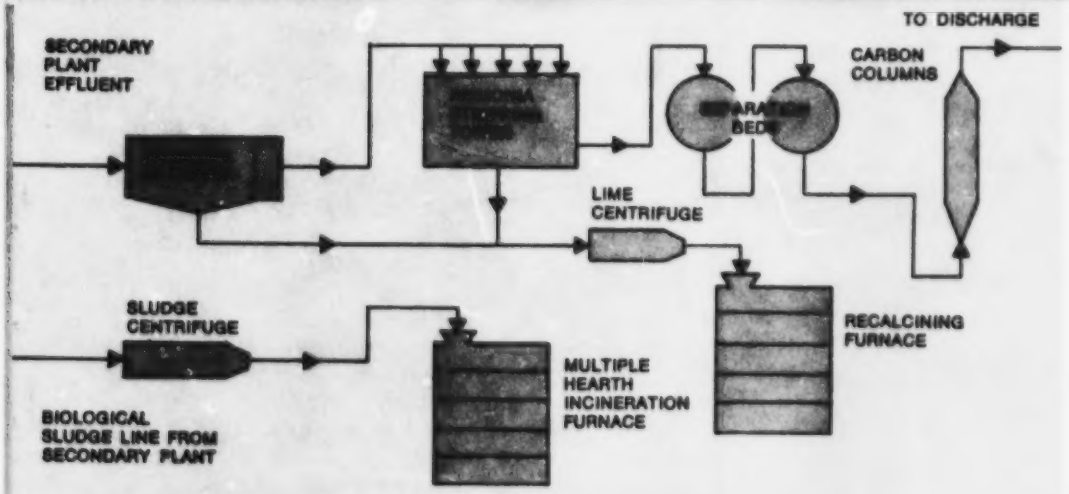
Along with great scenic beauty, favorable location and climate have made Lake Tahoe a year-around recreation center. In the South Tahoe area, the number of annual vacation visitors has increased nearly tenfold since 1950, and in that same period year-around residency has increased from 2,500 to almost 40,000.

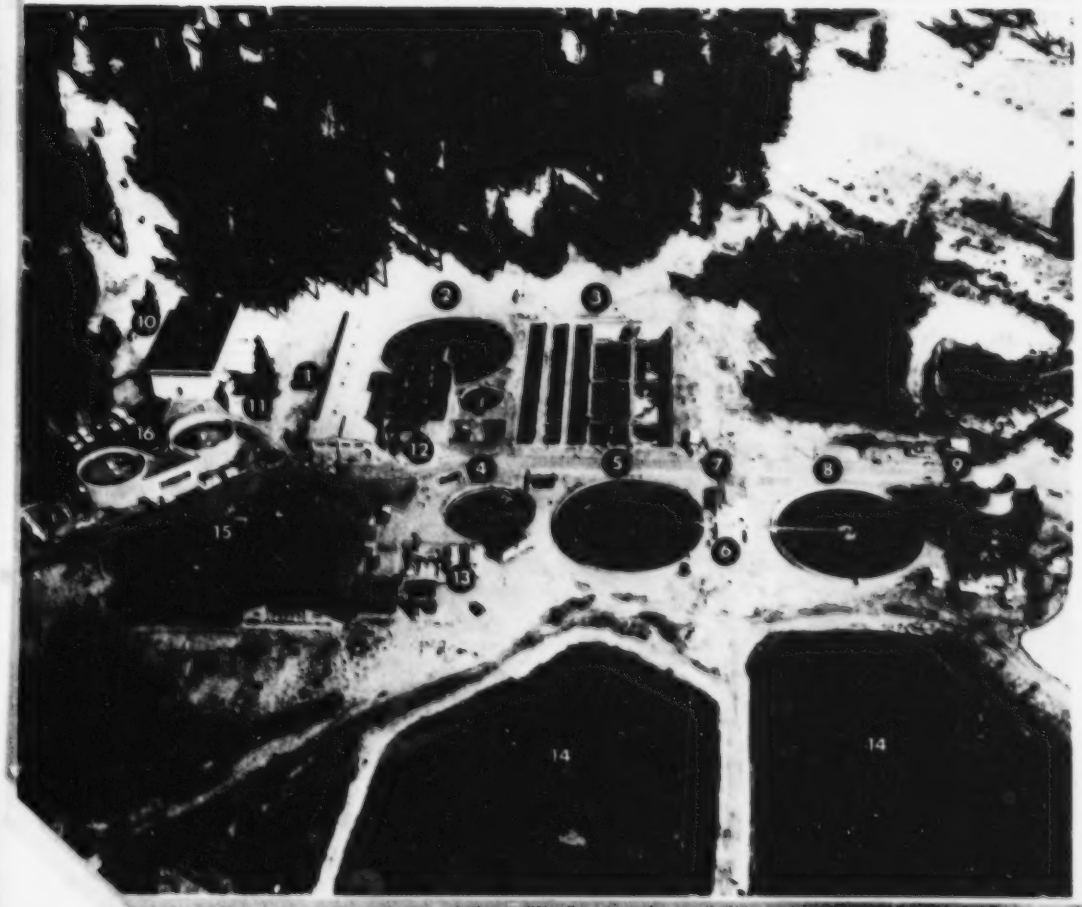
This mushrooming growth of resort and recreational developments around the south shore created a serious threat to Lake Tahoe. Drainage of sewage effluent into the lake could greatly accelerate the process of aging, called eutrophication, through which lakes eventually die. Organic material from the surrounding area seeps into the water and enriches it with nutrients which stimulate the growth of algae. As the algae growth increases, the water becomes turbid, and the lake eventually becomes a meadow. Eutrophication takes thousands of years by nature, but is greatly accelerated when nutrient-rich sewage effluents are allowed to drain into the lake.

To prevent this, the South Tahoe Public Utility District in 1961 started on a long-range program to develop a treatment process more advanced than conventional secondary treatment to handle waste disposal problems in the region. This resulted in the opening in 1965 of a new 2.5 mgd tertiary treatment plant. Growth in the region had outstripped the capacity of both the new tertiary plant and the existing secondary treatment facility. More capacity had to be added.

The present plant will process 7.5 million gallons of wastewater daily, sufficient to serve a city of 100,000 population. From primary treatment through sludge incinerator, the plant cost about $6 million to design and construct, part of which was met by federal grant funds, including a $1 million research and development grant from the Federal Water Pollution Control Administration.

The new plant produces water that is crystal clear, colorless and odorless, and practically free of trouble-causing phosphates and nitrogen. The reclaimed wastewater is so free from pollutants that it would be welcome almost anywhere except in the Tahoe basin. The laws of both California and Nevada require the export of all wastewater from the Tahoe basin by 1970. To meet this, the purified water is lifted 1,235 feet to an elevation of 7,735 feet at the Luther Pass summit, and transported through a 27-mile pipeline to the reservoir created by a rockfill dam on a dry tributary of Indian Creek.





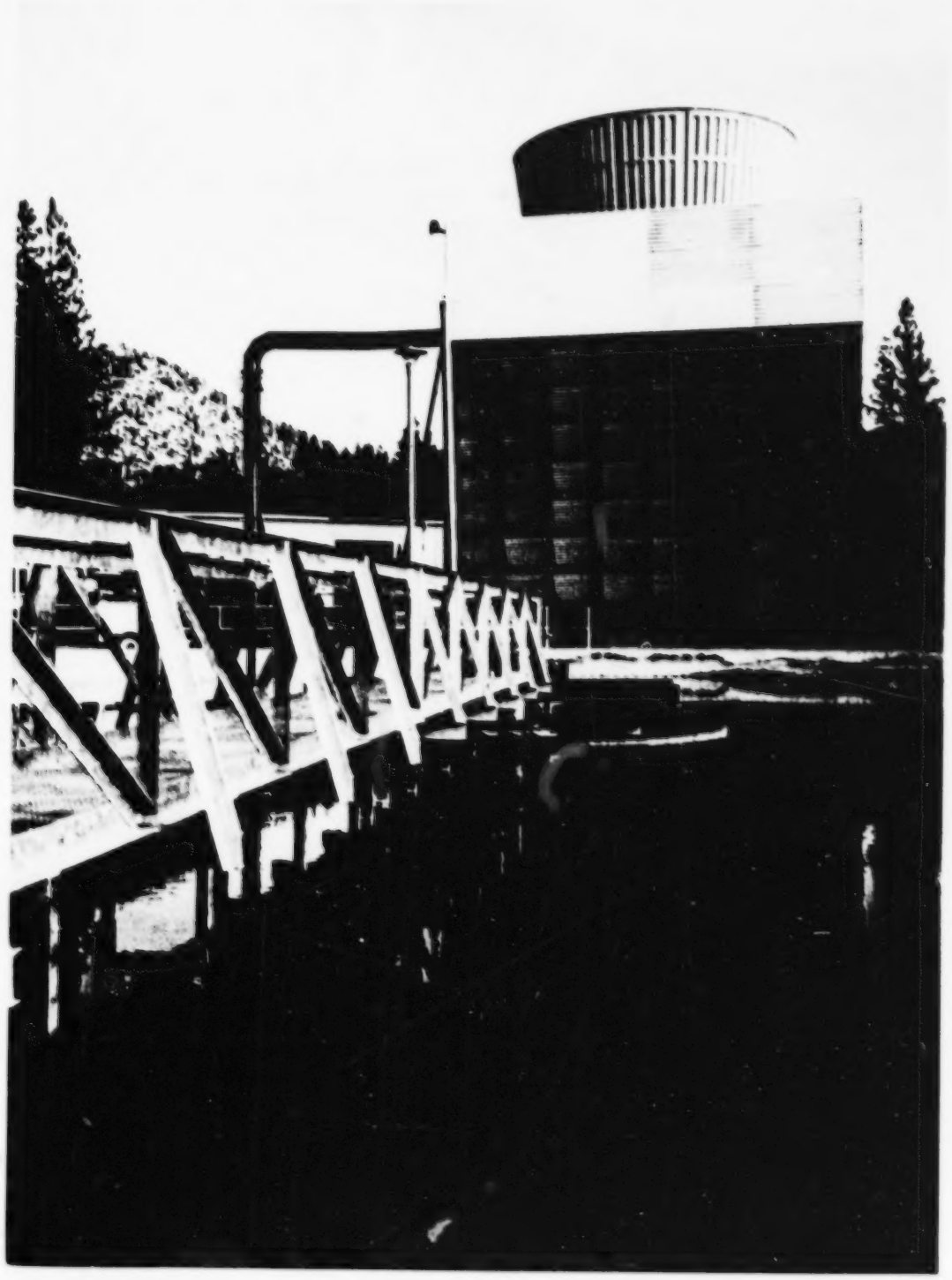
the Tahoe water reclamation process

The Tahoe process of purification and nutrient removal begins where conventional waste treatment systems end. Effluent from the secondary clarifier receives chemical clarification by the addition of lime as a coagulant. This removes the suspended matter and most of the phosphates. The high pH (11.5-12) effluent from the chemical clarifier is pumped to a lath-packed stripping tower which removes the ammonia-nitrogen. As it leaves the tower, the water is recarbonated to reduce the pH, using carbon dioxide recovered from furnace stack gases. Filtration on mixed media separation beds filters out remaining turbidity, phosphates and calcium carbonate. Final polishing is provided by granular activated carbon, which removes color, odor and almost all of the remaining organic material.

Costs are reduced by facilities for reclaiming materials for reuse. Spent carbon is regenerated in a six-hearth furnace, developing temperatures up to 1,700 degrees. Lime sludge is thickened in a centrifuge and recalcined in a similar furnace and carbon dioxide from the stacks is used for recarbonation.

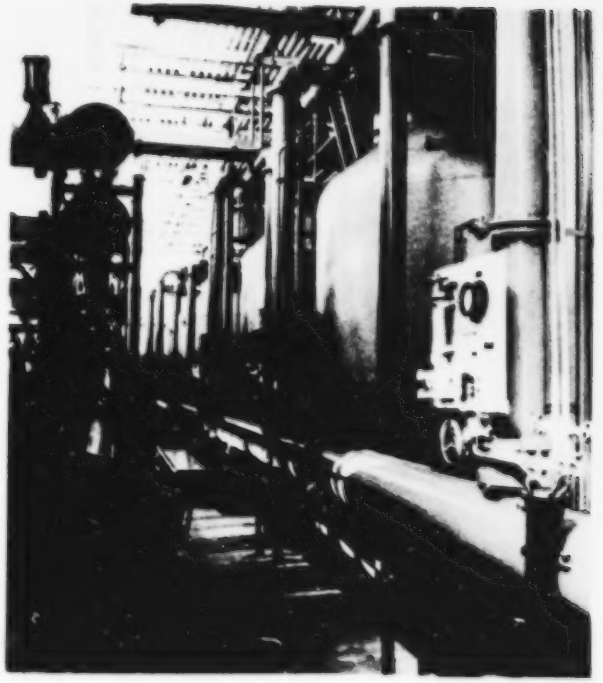
Disposal of the biological sludge from the primary and secondary treatment units is accomplished by burning it in a multiple-stage smokeless incinerator.

How advanced purification system starts where conventional waste treatment ends is shown in this aerial photograph of South Tahoe plant. (1) Headworks and primary sedimentation basin. (2) Primary sedimentation basin. (3) Activated sludge aeration tanks. (4) & (5) Secondary clarifier. (6) Chemical flocculation basin (start of advanced treatment process). (7) Return sludge pump station. (8) Chemical clarifier. (9) Nitrogen removal tower. (10) Separation beds and carbon columns. (11) Backwash decant tank. (12) Solids disposal building, housing sludge incinerator, lime recalcining furnace, dewatering facilities. (13) Plant effluent pump station. (14) Effluent storage ponds. (15) Administration building. (16) Sludge digesters (standby use only).



nitrogen removal

Removal of nitrogen is accomplished in a 50-foot-high forced ventilation stripping tower, the first of its kind used in a municipal wastewater plant. Because of the high pH of the lime-treated water discharging from the chemical clarifier, the ammonia is present as dissolved gas, rather than ammonium ion in solution. The tower is packed with treated hemlock slats spaced at 1½ inches vertically and 2 inches horizontally. As the water strikes a slat, droplets are formed, and the ammonia gas escapes from the droplet. High air circulation removes the ammonia gas as it escapes. Air enters through side louvers, travels horizontally through the packing to the center, where it is discharged upward through a fan which has a capacity of 700,000 cubic feet per minute.

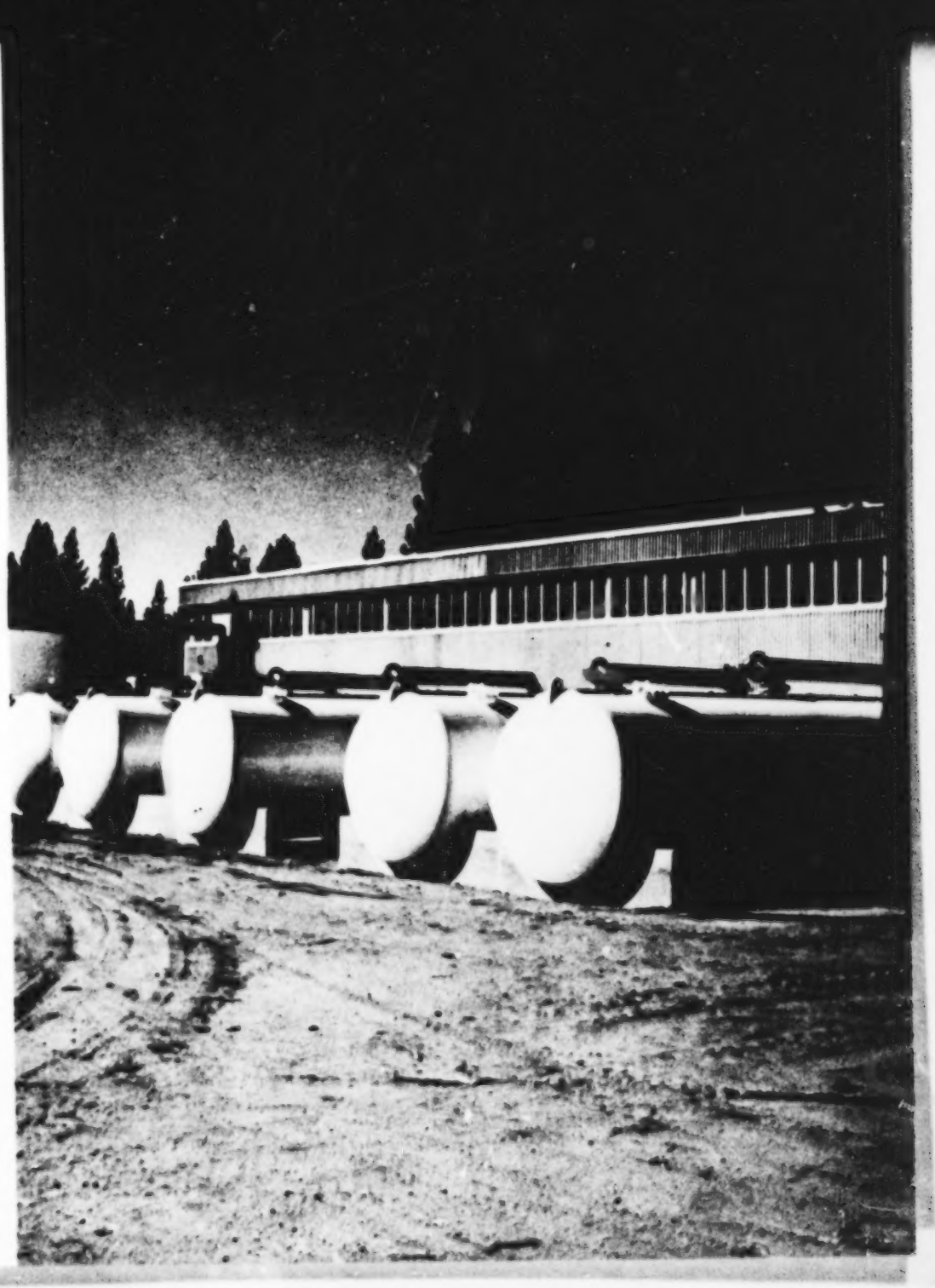


mixed media filtration

Effluent from the nitrogen stripping tower is recarbonated in two stages, using compressed carbon dioxide from furnace stack gases, to reduce the pH to the desired level in preparation for the next stage of treatment—filtration. Alum is added to the filter influent water. There are three pairs of pressure filter beds, with each pair operating in series as a unit. The mixed media filters, designed especially for filtering waste water, consist of coarse coal, medium sized sand and fine garnet, arranged from coarse to fine in direction of flow. The filters are equipped with rotary surface washers. Backwashing is triggered automatically by head loss or turbidity.

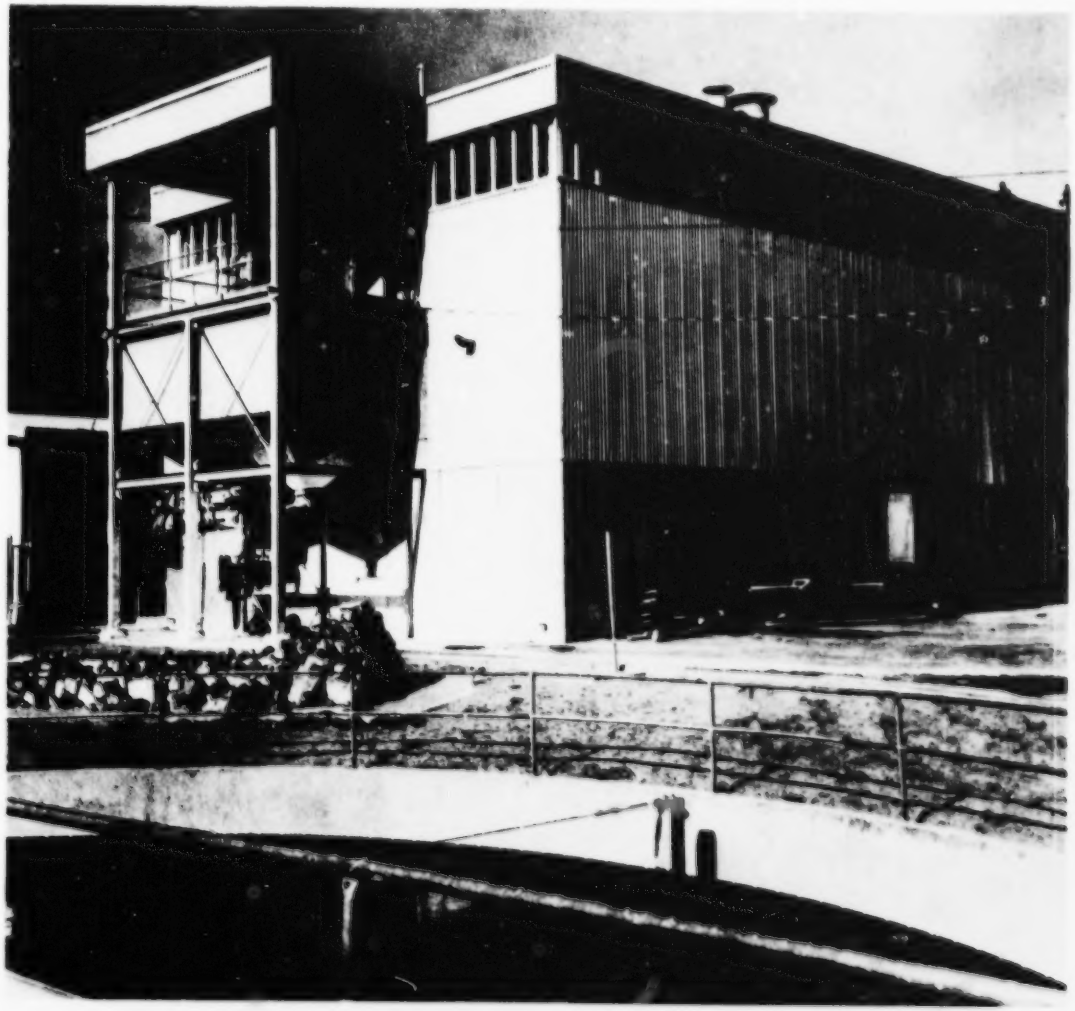
polishing on activated carbon

Final polishing is provided by adsorption on activated carbon. The filtered water flows under pressure to eight carbon columns which operate in parallel. Each column contains about 22 tons of 8 x 30 mesh granular activiated carbon. The upflow system, in which the flow of water is up from the bottom, permits hydraulic withdrawal of spent carbon at the bottom, the addition of fresh carbon at the top. This flow pattern provides for the effluent passing through the most active carbon as it leaves the plant. The carbon column effluent is colorless, odorless, low in organics, and of sparkling clarity.

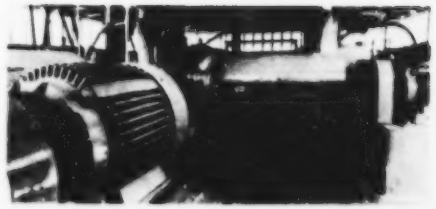


solids disposal and materials reclaiming

All solid plant wastes are processed in multiple hearth furnaces. The biological and waste chemical sludges are incinerated. The lime mud is recalcined and reused in the process. The spent granular carbon is regenerated and reused.

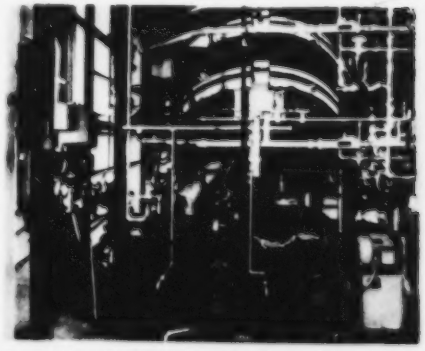


The solids disposal building houses sludge dewatering and incineration system and lime recalcining furnace. Note absence of smoke from the furnace stack.

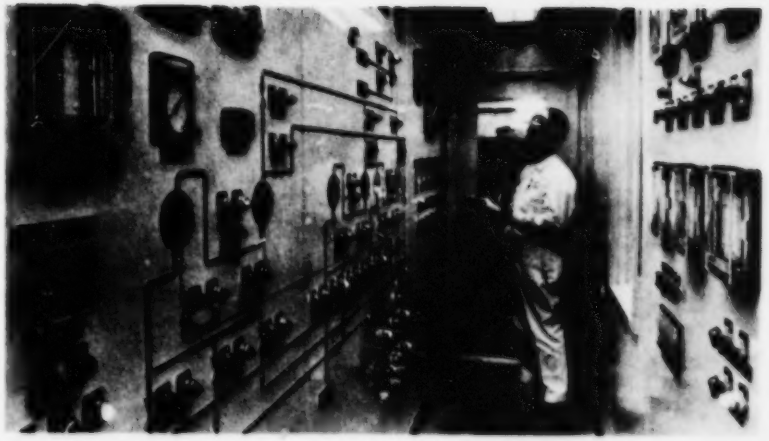


Biological sludge from the primary and secondary treatment units and lime sludge from chemical clarifier are thickened in centrifuges before incineration or recalcination. Phosphates are removed from the system by feeding about 25 per cent of the recalcined lime into the primary treatment tanks, where it is drawn off with the biological sludge.

Air scrubbers (foreground) cool and wash furnace gases to remove particulate matter. There is no odor, smoke or steam plume, and no air pollution.



Organic materials removed by the carbon are consumed when the saturated carbon is regenerated in a multi-hearth furnace operated at 1,680 degrees F in a limited oxygen atmosphere. Attrition loss in full regeneration is about 5 per cent. Carbon is moved hydraulically in slurry form.



Plant Controls

Control panel for filter plant, carbon columns, is pictured above. All filter operations are fully automatic. Backwash is initiated by high head loss or high effluent turbidity. The beds are backwashed, filtered to waste and restored on line automatically. Effluent quality is measured and recorded.

Research

The entire wastewater purification plant, in a sense, is a research and development project. Original concepts incorporated in the design include a process for economical use of lime as a coagulant for solids removal; recovery and recalcination of lime for reuse; a stripping tower capable of large-scale removal of ammonia nitrogen; large-scale filtration of effluent; carbon columns for large scale removal of taste, odor, color, ABS from synthetic detergents, and trace organics; regeneration of carbon for reuse.

South Tahoe Public Utility District

Board of Directors: Robert W. Fesler, President; Robert W. Wakeman, Donald H. Kortes, Edward Hegarty, Gerald G. Ream, Directors; Russell L. Culp, General Manager.

Major Suppliers

BSP Corporation
Solids handling system, including furnaces for carbon regeneration, sludge incineration, lime recalcination.

Calgon Corp.
Granular activated carbon.

Bird Machine Company
Sludge and spent lime dewatering centrifuges.

Neptune MicroFLOC Corp.
Filter media, control panels and process patents.

Wallace & Tiernan
Gravimetric feeders and lime slakers.

The Marley Company
Nitrogen stripping tower equipment.

Byron Jackson Pump Company
Effluent pumps.

Dorr Oliver, Inc.
Primary, secondary and chemical clarifier; aeration equipment, lime mud thickener, sludge pumps.

Engineers

Clair A. Hill & Associates — Redding, Calif.
Consulting engineers for the South Tahoe Public Utility District.

Cornell, Howland, Hayes & Merryfield — Corvallis, Oregon
Design of the wastewater reclamation plant.

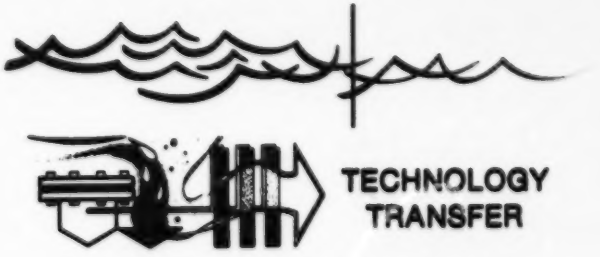
plant performance

Wastewater undergoes a number of cleaning operations, as illustrated by the samples taken at successive steps in the process. From left, raw sewage, primary effluent, activated sludge secondary effluent, chemical clarifier effluent, separation bed filtrate, and the final product, reclaimed water from the carbon columns. This process removes all of the suspended solids, color, odor and bacteria, 99.8 per cent of the BOD, 96 per cent of the COD, 98 per cent of the MBAS, 94 per cent of the phosphorous and 50 to 98 per cent of the nitrogen.

Quality Parameter	Raw Waste Water Influent	Activated Sludge Plant Effluent	Water Reclamation Plant		
			Nitrogen Removal Tower Effluent	Separation Bed Effluent	Chlorinated Carbon Effluent
MBAS (Methylene Blue absorbable substances) mg/1	4-9	0.4	0.4	0.4	0.1
COD (Chemical Oxygen Demand) mg/1	200-500	20-60	15-25	14-20	10
BOD (Biological Oxygen Demand) mg/1	250-300	15-30	5-10	4	1
Turbidity, JTUs	100	20-50	2-5	0.4	0.2
Suspended Solids, mg/1	225	10-20	5-10	0.9	0.9
Phosphorus, mg/1 as P	10-15	5.7	5.7	0.8	0.05
Ammonia Nitrogen, mg/1 as N	20-30	25-35	5-9	5-9	Converted to Chloramines
Coliform Bacteria MPN/100	15,000,000	150,000	150,000	15	under 2.2
Color, units	High	High	High	10-20	Colorless
Odor	Odor	Odor	Odor	Odor	Odorless

a new lake

This new 165-acre lake in Alpine County, California, contains only reclaimed sewage wastewater from the South Lake Tahoe plant. The lake will store over one billion gallons of water which is released into Indian Creek during the irrigation season for use on downstream ranches. The lake has been planted with rainbow trout, and a minimum water level will be maintained to permit recreational development.



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